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Application Number	Filed
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US005843073A

United States Patent [19]

Sinofsky

[11] Patent Number: 5,843,073

[45] Date of Patent: *Dec. 1, 1998

[54] **INFRARED LASER CATHETER SYSTEM**

[75] Inventor: **Edward Lawrence Sinofsky**, Reading, Mass.

[73] Assignee: **Rare Earth Medical, Inc.**, West Yarmouth, Mass.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 4,917,084.

[21] Appl. No.: **411,581**

[22] Filed: **Mar. 29, 1995**

Related U.S. Application Data

[60] Continuation of Ser. No. 49,147, Apr. 19, 1993, which is a division of Ser. No. 568,348, Aug. 15, 1990, which is a continuation of Ser. No. 257,760, Oct. 14, 1988, Pat. No. 4,950,266, which is a continuation of Ser. No. 14,990, Feb. 17, 1987, abandoned, which is a continuation of Ser. No. 761,188, Jul. 13, 1985, abandoned.

[51] **Int. Cl.**[6] **A61N 5/06**

[52] **U.S. Cl.** **606/10**; 606/3; 606/7; 606/15

[58] **Field of Search** 606/2, 3–19; 600/104, 600/108

[56] **References Cited**

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1,751,584	3/1930	Hansell .
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144764	6/1985	European Pat. Off. .
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"Comparative Thermal Modeling of Er:YAG, Ho:YAG and C02 Laser Pulses for Tissue Vaporization, Proceedings for SPIE" by Ed Sinofsky, The International Society for Optical Engineering, vol. 712, Lasers In Medicine (1986), pp. 188–192. *

"Reduction of Laser Inducted Pathological Tissue Injury Using Post–Energy Delivery", by L. Deckelbaum et al., vol. 56, Oct. 1, 1985, pp. 662–667. *

(List continued on next page.)

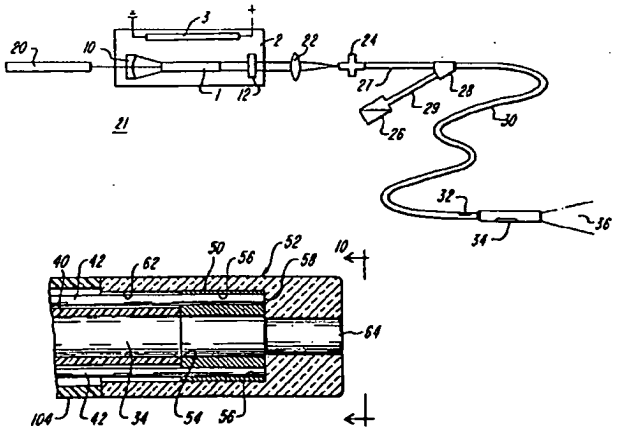
Primary Examiner—David M. Shay

Attorney, Agent, or Firm—Thomas J. Engellenner; Lahive & Cockfield, LLP

[57] **ABSTRACT**

Laser energy produced by a laser operating in the mid-infrared region (approximately 2 micrometers) is delivered by an optical fiber in a catheter to a surgical site for biological tissue removal and repair. Disclosed laser sources which have an output wavelength in this region include: Holmium-doped Yttrium Aluminum Garnet (Ho:YAG), Holmium-doped Yttrium Lithium Fluoride (Ho:YLF), Erbium-doped YAG, Erbium-doped YLF and Thulium-doped YAG. For tissue removal, the lasers are operated with relatively long pulses at energy levels of approximately 1 joule per pulse. For tissue repair, the lasers are operated in a continuous wave mode at low power. Laser output energy is applied to a silica-based optical fiber which has been specially purified to reduce the hydroxyl-ion concentration to a low level. The catheter may be comprised of a single optical fiber or a plurality of optical fibers arranged to give overlapping output patterns for large area coverage.

13 Claims, 6 Drawing Sheets



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